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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES

In re Appln. of: J. G. Woods et al.
Title: Process for Hydroxyalkylating Carboxylic Acid-Functionalized
Materials
Application No: 09/341,287
Filed: August 19, 1999
Atty. Docket No.: 1221.002USU/LC-302/PCT/US
Examiner: D. R. Wilson
Art Unit: 1713

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF UNDER 35 U.S.C. §134

Sir:

This Appeal Brief is filed under 35 U.S.C. §134 and in accordance with the provisions of 37 C.F.R. §1.192(a), and complies with the requirements set forth in 37 C.F.R. §1.192(c).

The claims herein on appeal are set forth in the Appendix.

As required by 37 C.F.R. §1.192, this Appeal Brief is filed in triplicate.

Appellants believe that no additional fees are due in connection with the filing of the enclosed Notice of Appeal and this Appeal Brief. Notice of Appeal and the Appeal

Application No.: 09/341,287
Art Unit: 1713

Brief fees have already been paid by Appellants for the Notice of Appeal and the Appeal Brief filed on May 20, 2002 and September 30, 2002, respectively, in the above identified application. Nonetheless, in the event additional fees are due, the Commissioner is hereby authorized to charge any such fees in this connection, or credit any overpayment, to Deposit Account No. 01-0467 in the name of Ohlandt, Greeley, Ruggiero & Perle, LLP.

REAL PARTY IN INTEREST

The real party in interest is Henkel Loctite Corporation, having a business address at 1001 Trout Brook Crossing, Rocky Hill, Connecticut 06067, USA.

RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to the Appellants that will affect, or be affected by, or have a bearing on, the Board's decision in the pending appeal.

STATUS OF CLAIMS

Claims 23-28, 31, 34-37 and 43 have been rejected in an Advisory Action dated November 6, 2003 and are the subject of this appeal.

Claims 23-28, 31, 34-37 and 43 are attached in the Appendix. Claims 29-30, 32-33 and 41-42 drawn to non-elected species, which are not included in the Appendix, may be rejoined upon allowance of the subject claims. Claims 38-40 drawn to non-elected inventions, are also not included in the Appendix.

STATUS OF AMENDMENTS

An Amendment dated November 5, 2001 was filed together with a Declaration under 37 C.F.R. § 1.132 after an interview with the Examiner on October 2, 2001 in response to a rejection of the pending claims in an Office Action dated July 3, 2001. The rejection of the pending claims, namely claims 23-28, 31, 34-37 and 43, was made final in an Office Action dated February 20, 2002. A first Appeal Brief was filed on December 9, 2002.

Prosecution was reopened by the Examiner on February 7, 2003, through the issuance of an Office Action. With further amendment of claims 23, 36 and 43 in a Response to Office Action dated June 9, 2003, claim 43 was amended to its present form. The pending claims were examined and rejected in an Office Action dated August 12, 2003 ("the final Office Action").

After still further amendment, claim 23 was amended to its present form by introducing the limitations of the previously examined claim 43 into claim 23 such that the scope of claim 23, as amended, and the scope of the previously examined claim 43 became identical.

Appellants had amended claim 23 to indicate that dihydroxyl-functionalized material has a molecular weight that is substantially unchanged relative to the molecular weight of the dicarboxylic acid-functionalized starting material, as it has been shown on pages 9 and 12 of the specification and concluded by the Examiner on page 3 of the Office Action dated February 7, which conceded that Appellants had indeed shown that the hydroxyalkylation process according to the present invention was carried out without substantially increasing the molecular weights of the starting materials.

Application No.: 09/341,287
Art Unit: 1713

An Advisory Action dated November 6, 2003 was issued which stated that the amendment of claim 23 would not be entered because it raises "new issues." Amendment of claim 23 to its present form by introducing the recitations of the previously examined claim 43 into claim 23 does not raise "new issues." Claim 23 and previously examined claim 43 are of identical scope. Therefore, claim 23 should be entered for purposes of Appeal. Appellants stand ready to cancel claim 43 if claim 23 is either entered or allowed.

The rejection of claims 23-28, 31, 34-37 and 43 under 35 U.S.C. §103 are overcome by amendments, Declaration under 37 C.F.R. §1.132 and arguments presented throughout the prosecution and in this Appeal Brief.

SUMMARY OF INVENTION

The present invention includes a process for preparing a dihydroxyl-functionalized material by hydroxyalkylating a dicarboxylic acid-functionalized material using a hydroxyalkylating reagent, in the presence of a phase transfer catalyst.

More particularly, the process of the present invention includes the step of reacting: (a) a dicarboxylic acid-functionalized polymer of polybutadiene, poly(butadiene-co-acrylonitrile), poly(acrylonitrile) or combinations thereof; and (b) a hydroxyalkylating reagent, such as, a carbocyclic carbonate. The reaction is carried out in the presence a phase transfer catalyst, such as, tetraethylammonium iodide.

The dihydroxyl-functionalized material has a molecular weight that is substantially unchanged relative to the molecular weight of the dicarboxylic acid-functionalized starting material.

The invention provides a process for preparing a dihydroxyl-functionalized material that has a molecular weight that is substantially unchanged relative to the

Application No.: 09/341,287
Art Unit: 1713

molecular weight of the dicarboxylic acid-functionalized starting material. As a result, the dihydroxyl-functionalized material can be used in adhesive, coating or sealant compositions having improved properties, including toughness and elongation and curability through a gap of more than 40 mils.

STATEMENT OF ISSUES

The issues presented for review are:

I. Whether claims 23-28, 31, 34-37 and 43 are patentable under 35 U.S.C. §103(a) over the combination of Okamoto in view of Merck Index, Wu and/or Yoshino, in further view of Wu or Yoshino.

II. Whether claim 25 is patentable under 35 U.S.C. § 103 (a) over the combination of Okamoto in view of Merck Index, Wu and/or Yoshino, in further view of Wu or Yoshino as applied to claims 23-28, 31, 34-37 and 43 above.

GROUPING OF CLAIMS

Claims 23-28, 31, 34-37 and 43 form a group for contesting the rejection under 35 U.S.C. §103(a) as allegedly being obvious over U.S. Patent No. 4,444,692 to Okamoto (hereafter Okamoto), Merck Index, U.S. Patent No. 4,266,046 to Wu (hereafter Wu) and "Synthetic Studies with Carbonates. Part 6. Syntheses of 2-Hydroxyethyl Derivatives by Reactions of Ethylene Carbonate with Carboxylic Acids or Heterocycles in the Presence of Tetraethylammonium Halides or under Autocatalytic Conditions", J.C.S. Perkin I, 1266-72 (1977) by Yoshino (hereafter Yoshino), in further view of Wu or Yoshino.

The claims do not stand or fall together.

ARGUMENTS

The following arguments are directed to independent claim 23. However, these arguments also apply to each of the dependent claims 24-28, 31, 34-37 and 43, because claims 24-28, 31, 34-37 and 43 have been rejected on the same grounds as independent claim 23 and include all the recitations of the independent claim 23 and any intervening claims.

Accordingly, Appellants respectfully request that the following arguments be considered in relation to each of the dependent claims 24-28, 31, 34-37 and 43.

Lack of Motivation to Combine

To properly combine two or more references, there must be a teaching or a suggestion in the references to combine them. Without such a teaching or a suggestion, no motivation exists and the combination can not be made.

Hence, claims 23-28, 31, 34-37 and 43 have been rejected under 35 U.S.C. §103(a) as allegedly being obvious over Okamoto in view of Merck Index, Wu and/or Yoshino, in further view of Wu or Yoshino.

The Office Action relies upon Merck Index disclosure that ethylene oxide is "toxic" as its centerpiece to compensate for the lack of motivation to combine references that are as disparate as Okamoto with Wu or Yoshino. Appellants have pointed out before and repeat here that Okamoto does not suggest to modify Wu and/or Yoshino to produce the instantly claimed invention defined by claim 23, as amended. Further, Wu

does not suggest to modify Okamoto and/or Yoshino to produce the instantly claimed invention defined by claim 23, as amended. Still further, Yoshino does not suggest to modify Wu and/or Okamoto to produce the instantly claimed invention defined by claim 23, as amended.

Without such a suggestion to modify one or more references, neither Okamoto, Wu, Yoshino, nor any combination thereof suggests to modify the remaining references to produce the instantly claimed invention defined by claim 23, as amended herein. To properly combine two or more references, there must be a teaching or a suggestion in at least one of the references to combine with each of the remaining references to provide motivation for a person of ordinary skill in the art to combine.

The Office Action erroneously states that this requirement is met by the "Merck Index" disclosure, which states that ethylene oxide is a toxic chemical. This information, the Office Action contends, would be sufficient for a person of ordinary skill in the art to be motivated to select one or more of the references and combine with the remaining references to produce the instantly claimed invention defined by claim 23, as amended. However, neither Okamoto, Wu, Yoshino, nor any combination thereof suggests to modify the remaining references by using a less toxic material in combination with Okamoto, Wu and/or Yoshino to produce the process of the instantly claimed invention defined by claim 23, as amended herein, which process has the advantage of employing a relatively non-toxic starting material, such as, an alkylene carbonate.

The "Merck Index" disclosure relied upon by the present Office Action is based on a statement of advantages of the present invention over the methods of the prior art. The present application states that ethylene carbonate, which is the reagent employed as the hydroxylating agent in the present invention, has the advantage of being a low toxicity reagent relative to ethylene oxide, which has relatively high toxicity. The Office Action goes on to conclude, incorrectly in our view, that a person of ordinary skill in the

art would have sufficient **motivation to combine** the cited references to arrive at the process defined by the instant claims, simply because one reagent is a reagent that has lower toxicity relative to ethylene oxide.

Not even the "Merck Index" disclosure suggests that ethylene oxide could be replaced with a less toxic starting material, such as, an alkylene carbonate. Thus, **none of the cited references teaches or suggests how to modify the various processes described in the remaining references** to arrive at the process defined by claim 23, as amended herein. There is no suggestion in any combination of the four cited references that provide motivation for a person of ordinary skill in the art to: (1) replace ethylene oxide with ethylene carbonate; and (2) further replace a tertiary amine catalyst with a phase transfer catalyst. To suggest that the four cited references can be combined in some fashion by a person of ordinary skill in the art to produce the instantly claimed invention, which is defined by claim 23, as amended herein, **the Office Action has been forced to utilized hindsight reconstruction to fashion a motivation to combine**.

In this, replacement of the ethylene oxide/tertiary amine catalyst by a carbocyclic carbonate/phase transfer catalyst in the process of Okamoto is not taught or suggested by any of the cited art or any combination thereof. Thus, a combination of references without a specific suggestion or a teaching to modify the references to produce the instantly claimed invention cannot form the basis for a rejection except, as it is in the present case, by **hindsight reconstruction**, which is improper.

Regarding the toxicity of ethylene oxide, the Office Action alleges that, because ethylene oxide is a hazardous material, it would be undesirable to use it as a reactant. This assumption is derived from the statement of advantages of the present invention over the methods of the prior art. It is not however taught or suggested by any of the cited documents of record, including the Merck Index.

The Office Action incorrectly assumes that, because ethylene oxide is rather hazardous, a person of ordinary skill in the art would automatically want to replace it with a less hazardous reactant. Based on this erroneous assumption, the Office Action concludes that a person of ordinary skill in the art upon learning that a starting material is hazardous, would be motivated to embark on a search for an alternative. This assumption is incorrect for the following reasons:

- (1) nearly all chemicals used in the chemical industry, including ethylene oxide, are toxic to one degree or another to humans, animals and the environment;
- (2) despite the toxicity, millions of pounds of ethylene oxide are produced annually by the chemical industry;
- (3) ethylene oxide is very attractive starting material because it is inexpensive;
- (4) ethylene oxide does not produce any by-products, such as, CO_2 , that requires disposal, as would be required if ethylene oxide were replaced with an alkylene carbonate; and
- (5) hydroxyalkylation of a carboxyfunctional material using an alkylene carbonate, such as, ethylene carbonate, as the hydroxyalkylating agent, only 50% of the weight of the ethylene carbonate would be added to the carboxyfunctional material, with the remaining 50% being lost as CO_2 , a by-product. Because ethylene carbonate is so much more expensive than ethylene oxide, the 50% weight loss, which would lead to doubling the raw material cost, would likely quadruple the manufacturing cost. In view of such a dramatic increase in cost, a person of ordinary skill in the art would not only

have no motivation to replace ethylene oxide with ethylene carbonate, but **would be motivated to avoid replacing ethylene oxide altogether**.

Clearly, a person of ordinary skill in the art would not be motivated to look for a replacement for ethylene oxide simply because of its toxicity. The mere fact that a chemical is hazardous is not, in and of itself, a suggestion to replace ethylene oxide with another chemical, particularly in the present case, because ethylene oxide is an **inexpensive** hydroxyalkylating agent. The "added cost to provide the necessary safety and protection" argument previously advanced by the Examiner is not persuasive because ethylene oxide is so **inexpensive** that safety costs would not be sufficient to offset the higher cost of alternative reagents. Accordingly, Appellants point out that the recognition of the advantages of the present invention does not fulfill the necessary motivation requirement to look for alternatives or to combine Okamoto with Wu or Yoshino.

In addition, the molecular weight of ethylene carbonate is twice the molecular weight of ethylene oxide. In the hydroxyalkylation of a carboxyfunctional material using ethylene oxide as the hydroxyalkylating agent, 100% of the weight of the ethylene oxide would be added to the carboxyfunctional material, so that all of the hydroxyalkylating agent is retained in the reaction product without any loss of material.

In sharp contrast, in the hydroxyalkylation of a carboxyfunctional material using ethylene carbonate as the hydroxyalkylating agent, only 50% of the weight of the ethylene carbonate is added to the carboxyfunctional material. The remaining 50% is lost as CO₂, a by-product that requires disposal. Thus, the 50% weight loss and doubling the raw material cost would quadruple the raw material costs, so that a person of ordinary skill in the art would not have motivation to replace ethylene oxide with ethylene carbonate.

The instant claims are rejected as being obvious over an "advantage" described in the present application, with a requirement to combine that advantage with four additional references, none of which teaches or suggests how to modify the various processes described in the remaining references to arrive at the process defined by the instant claims.

Appellants point out that recognition of an advantage, which typically occurs either concurrent with or post-invention, does not provide a person of ordinary skill in the art motivation to modify one or more of the remaining four cited references to achieve that advantage. The instant claims are rejected as being obvious over an "advantage" described in the present application, with a requirement to combine that advantage with four additional references. Thus, recognition by Appellants of an advantage that the instant process provides, which solves a problem of the prior art, such as, replacement of a toxic starting material with a less toxic starting material, is in itself inventive. Recognition of the source of a problem is in fact sufficient to serve as one of several indicia for non-obviousness.

The Examiner has clearly used Appellant's application as a blue print in creating his section 103 rejections. This approach is long recognized as improper. Indeed, the Examiner must cast his mind back in time to when the invention was discovered and consider the invention as claimed without the benefit of the application itself.

Further, ability to control the molecular weight of the hydroxyalkylated final product is advantageous for producing a useful hydroxyalkylated final product. The process according to the present invention provides means for controlling the molecular weight of the hydroxyalkylated final product produced and, as a result, avoids extensive resin extension. This is an unexpected result not taught or suggested by any of the cited references or any combination thereof.

The absence of excessive resin extension in the dihydroxyl-functionalized material, is an important aspect of the present invention because low fusible-materials and block prepolymer resins prepared from HTBNs and organic diisocyanates are constrained by the permissible molecular weights of the reactants to achieve appropriate physical properties in the final product. High molecular weight materials would not be useful in the compositions of the present invention.

In view of the foregoing, a person of ordinary skill in the art would not be motivated to replace ethylene oxide with ethylene carbonate. Instead, such a person, through the knowledge of a person of ordinary skill in the art, would avoid replacing the ethylene oxide.

Absent a teaching or suggestion to provide motivation to combine, the cited references are not properly combinable because a person of ordinary skill in the art would not be able to arrive at the claimed invention except through either extensive experimentation or impermissible hindsight.

In an effort to advance prosecution on the merits (though without conceding the propriety of the rejections advanced during the extended prosecution), Appellants have amended claim 23 by defining that the "dihydroxyl-functionalized material has a molecular weight that is substantially unchanged relative to the molecular weight of said dicarboxylic acid-functionalized starting material." Thus, claim 23, as amended, incorporates this surprising and unexpected characterization so that **claim 23 is allowable at least for this reason alone.**

As mentioned previously, the toxicity of a chemical alone is insufficient to provide the requisite motivation, which is missing in the above-cited references, to replace ethylene oxide with ethylene carbonate and further replace the tertiary amine catalyst with a phase transfer catalyst and still further, replace the various carboxylic acid

starting materials with a dicarboxylic acid-functionalized polymer of polybutadiene, poly(butadiene-co-acrylonitrile), poly(acrylonitrile) or a combination thereof to prepare a dihydroxyl-functionalized material.

Even if all the elements of a claim are described in separate references, there has to be provided a teaching or a suggestion in the references to provide motivation for a person of ordinary skill in the art to combine the references in question. Thus, a showing of motivation is one of the essential requirements that must be met to establish a *prima facie* case of obviousness (see MPEP § 2142 and *In re Rouffet*, 149 F.3d 1350, 1359, 47 USPQ2d 1453, 1457-1458 (Fed. Cir. 1998)).

In the absence of a teaching or a suggestion of the desirability of such a replacement, the cited references alone or in combination do not render the claims of the instant invention obvious (see MPEP 2143.01). Thus, the criteria for establishing a *prima facie* case of obviousness have not been met (see MPEP 2143, citing *In re Vaeck*, 947 F.2d 488, 20 USPQ 2d 1438 (Fed. Cir. 1991)).

Simply put, none of the cited references discloses, teaches or suggests to select various elements from a large number of references and combine them in a manner that provides a reasonable expectation of success in producing a process according to the present invention.

In addition, none of the cited references discloses, teaches or suggests the desirability of replacing the ethylene oxide/tertiary amine catalyst in one reference by a carbocyclic carbonate/phase transfer catalyst of another with a reasonable expectation of success. Thus, in the absence of a disclosure, teaching or a suggestion of the desirability of making such a replacement, the cited references alone or in combination do not render the claims of the instant invention obvious (see MPEP 2143.01).

Application No.: 09/341,287
Art Unit: 1713

Further, four documents have been cited against the pending claims. Nowhere in any of the four cited documents is there a suggestion to make the mixing and matching done by the Examiner to construct the obviousness rejection, or that such mixing and matching be performed concurrently.

Accordingly, the criteria for establishing a *prima facie* case of obviousness have not been met (see MPEP 2143, citing *In re Vaeck*, 947 F.2d 488, 20 USPQ 2d 1438 (Fed. Cir. 1991)).

Therefore, the rejection of claims 23-28, 31, 34-37 and 43 under 35 U.S.C. §103(a) as being obvious should be reversed and those claims should be allowed.

Independent Claim 23:

The Advisory Action dated November 6, 2003 stated that the amendment of claim 23 would not be entered because it raises "new issues."

Appellants believe that amendment of claim 23 to its present form by introducing the recitations of the previously examined claim 43 into claim 23 does not raise "new issues". The Examiner has not provided a proper basis for his decision not to enter the amendment of claim 23. Moreover, the Examiner has not provided any basis supporting his rejection of claim 23. Therefore, Appellants respectfully request that claim 23, as amended, be entered for purposes of Appeal. Appellants request that an explanation of how the amended claim is rejected should also be provided.

As noted, claims 23-28, 31, 34-37 and 43 have been rejected under 35 U.S.C. §103(a) as allegedly being obvious over Okamoto in view of Merck Index, Wu and/or Yoshino, in further view of Wu or Yoshino.

Application No.: 09/341,287
Art Unit: 1713

The final Office Action has continued to apply an improper rejection of claim 23 that is carried over from previous Office Actions. Even though the 35 U.S.C. §103(a) rejection in the present Office Action has been slightly modified from the earliest rejections, it is still an "omnibus" rejection, and as such, is still improper because the combination of the references that is relied upon for the rejection is unclear, confusing and in part meaningless.

Okamoto	<u>in view of</u>	Merck Index	<u>in further view of</u>	Wu
		Wu	<u>or</u>	
		<u>and/or</u>		Yoshino
		Yoshino		

The 35 U.S.C. §103(a) rejection based on the above combination of references requires "Wu" to be "in further view of" itself. Further, the combination requires "Yoshino" to be "in further view of" itself.

Accordingly, the rejection of claims 23-28, 31, 34-37 and 43 under 35 U.S.C. §103(a) as allegedly being obvious over Okamoto in view of Merck Index, Wu and/or Yoshino, in further view of Wu or Yoshino is at best unclear, confusing and in part meaningless, and thus, the rejection of these claims based on the stated combination is improper.

If for the sake of argument one assumes that the intended combination of references is being obvious over Okamoto in view of Merck Index, Wu and/or Yoshino, in further view of Wu or Yoshino Appellant's arguments include the following:

(a) The rejection relies upon the Merck Index disclosure as its centerpiece to provide motivation to combine these disparate references. However, the information in the Merck Index disclosure is also found in the specification and appears there as a statement of advantages of the present invention over the methods of the prior art.

The application states that ethylene carbonate, which is the reagent employed as the hydroxylating agent in the present invention, has the advantage of being a low toxicity reagent relative to ethylene oxide, which has relatively high toxicity. The final Office Action concludes incorrectly that a person of ordinary skill in the art would have sufficient **motivation to combine** the cited references to arrive at the process defined by the instant claims.

As demonstrated above, there is a lack of a disclosure, teaching or suggestion of the desirability of combining the cited references. Thus, no motivation to combine them exist, and as such, a *prima facie* case of obviousness has not been established.

(b) Regarding the toxicity of ethylene oxide and that nearly all chemicals used in the chemical industry, including ethylene oxide, are toxic to one degree or another to humans, animals and the environment and despite this, millions of pounds of ethylene oxide are produced annually by the chemical industry.

Thus, a person of ordinary skill in the art would not be motivated to look for a replacement for ethylene oxide simply because of its toxicity. The mere fact that a chemical is hazardous is not, in and of itself, a suggestion to replace ethylene oxide with another chemical, particularly in the present case, because ethylene oxide is an **inexpensive** hydroxyalkylating agent. The "added cost to provide the necessary safety and protection" argument advanced by the Examiner is not persuasive because ethylene oxide is so **inexpensive** that safety costs would not be sufficient to offset the higher cost of alternative reagents. Accordingly, Appellants points out that the

recognition of the advantages of the present invention does not fulfill the necessary motivation requirement to look for alternatives or to combine Okamoto with Wu or Yoshino.

(c) Appellants have submitted a Declaration under 37 C.F.R. § 1.132 to show that a person of ordinary skill in the art would not be motivated to replace ethylene oxide with ethylene carbonate.

More specifically, the Declaration states that nearly all chemicals used in the chemical industry, including ethylene oxide, are toxic to one degree or another. Despite this, millions of pounds of ethylene oxide are produced and used annually by the chemical industry. Thus, one would not automatically replace ethylene oxide for being hazardous. As mentioned above, ethylene and propylene oxides are so inexpensive that any added safety costs associated with their use would be insufficient to offset the higher cost of ethylene and propylene carbonates and thus, would not provide sufficient motivation to replace ethylene oxide with ethylene carbonate.

In addition, the molecular weight of ethylene carbonate is twice the molecular weight of ethylene oxide. In the hydroxyalkylation of a carboxyfunctional material using ethylene oxide as the hydroxyalkylating agent, 100% of the weight of the ethylene oxide would be added to the carboxyfunctional material, so that all of the hydroxyalkylating agent is retained in the reaction product without any loss of material.

In sharp contrast, in the hydroxyalkylation of a carboxyfunctional material using ethylene carbonate as the hydroxyalkylating agent, only 50% of the weight of the ethylene carbonate is added to the carboxyfunctional material. The remaining 50% is lost as CO₂, a by-product that requires disposal. Thus, the 50% weight loss and doubling the raw material cost would quadruple the raw material costs, so that a person

Application No.: 09/341,287
Art Unit: 1713

of ordinary skill in the art would not have motivation to replace ethylene oxide with ethylene carbonate.

An Office Action dated February 7, 2003 had referred to the high cost of ethylene oxide available from Aldrich Chemical, Inc.

Appellants point out that chemical plants that use ethylene oxide do not purchase this chemical from Aldrich, which provides ethylene oxide as a "research" chemical in small cylinders, instead of a chemical in industrial scale quantities available at more favorable pricing. Accordingly, reference to the high cost of ethylene oxide from Aldrich is not relevant to the issue of motivation.

(d) Replacement of the ethylene oxide/tertiary amine catalyst by a carbocyclic carbonate/phase transfer catalyst in the process of Okamoto is not disclosed, taught or suggested by the cited references.

Okamoto describes a process for preparing a hydroxyl-terminated polymer using:

- (i) ethylene oxide; and
- (ii) a tertiary amine catalyst.

The final Office Action alleges that, because ethylene oxide is a hazardous material, it would be undesirable to use it as a reactant. This assumption is derived from the statement in the subject application itself of advantages of the present invention over known methods.

Wu describes a process for preparing polyesters of polycarboxylic acids using a cyclic carbonate with a monomeric polyfunctional carboxylic acid in the presence of an alkylammonium halide catalyst.

Yoshino describes preparation of a mixture of mono- and di-esters of ethylene glycol with a mono-carboxylic acid by the reaction of a monocarboxylic acid with ethylene carbonate in the presence of an alkylammonium halide catalyst.

The differences between the disclosures of these references and the invention defined by the instant claims is as follows:

Okamoto describes a process for preparing a hydroxyl-terminated polymer using ethylene oxide/tertiary amine catalyst combination but does not use carbocyclic carbonate/phase transfer catalyst combination.

Wu uses a cyclic carbonate/ alkylammonium halide catalyst with a monomeric polyfunctional carboxylic acid, such as, terephthalic acid, as the starting material, to prepare polyesters but does not use a dicarboxylic acid-functionalized polymer of polybutadiene, poly(butadiene-co-acrylonitrile), poly(acrylonitrile) or a combination thereof to prepare a dihydroxyl-functionalized material.

Yoshino uses ethylene carbonate/alkylammonium halide catalyst with a mono-carboxylic acid as the starting material to prepare a mixture of mono- and di-esters of ethylene glycol but, as in the case of Wu, does not use a dicarboxylic acid-functionalized polymer of polybutadiene, poly(butadiene-co-acrylonitrile), poly(acrylonitrile) or a combination thereof to prepare a dihydroxyl-functionalized material.

There is no teaching or suggestion in either Wu or Yoshino to use a dicarboxylic acid-functionalized polymer of polybutadiene, poly(butadiene-co-acrylonitrile), poly(acrylonitrile) or a combination thereof to prepare a dihydroxyl-functionalized material.

Conversely, there is no disclosure, teaching or suggestion in Okamoto to replace ethylene oxide/tertiary amine catalyst combination with ethylene carbonate/phase transfer catalyst such as, alkylammonium halide.

There is no suggestion in Okamoto to replace the basic tertiary amine catalyst with a neutral phase transfer catalyst. There is no suggestion in either Wu or Yoshino that phase transfer catalysts and tertiary amine catalyst are equivalent or interchangeable. There is no suggestion in any of the references that the basic tertiary amine catalyst can be replaced with a neutral phase transfer catalyst, or *vice versa*, and obtain the same result. In fact, one of ordinary skill in the art would expect that a contrary result would be achieved.

Further, neither Wu nor Yoshino disclose, teach or suggest that the various starting materials used in either Wu or Yoshino could be replaced with a dicarboxylic acid-functionalized polymer of polybutadiene, poly(butadiene-co-acrylonitrile), poly(acrylonitrile) or a combination thereof to prepare a dihydroxyl-functionalized material.

A person of ordinary skill in the art would have to instinctively know how to pick and choose the right ingredients from one reference and simultaneously pick and choose the right ingredients from another reference to come up with the exact combination of ingredients to produce all the elements of the instant process. Thus, without a specific suggestion to modify the various teachings to obtain the claimed process of the present invention, Wu or Yoshino are not combinable with Okamoto.

(e) Controlling the molecular weight of the hydroxyalkylated final product is advantageous for producing a useful hydroxyalkylated final product. The process according to the present invention provides a way to control the molecular weight of the hydroxyalkylated final product produced and, as a result, avoids extensive resin extension.

This is an unexpected result not taught or suggested by any of the cited references.

The absence of excessive resin extension in the dihydroxyl-functionalized material, is an important aspect of the present invention because low fusible-materials and block prepolymer resins prepared from HTBNs and organic diisocyanates are constrained by the permissible molecular weights of the reactants to achieve appropriate physical properties in the final product. High molecular weight materials would not be useful in the compositions of the present invention.

As shown above, there is no disclosure, teaching or suggestion in any combination of the cited references that provide motivation for a person of ordinary skill in the art to replace ethylene oxide with ethylene carbonate and further replace a tertiary amine catalyst with a phase transfer catalyst.

The toxicity of a chemical alone is insufficient to provide the requisite motivation, which is missing in the above-cited references, to replace ethylene oxide with ethylene carbonate and further replace the tertiary amine catalyst with a phase transfer catalyst and still further, replace the various carboxylic acid starting materials with a dicarboxylic acid-functionalized polymer of polybutadiene, poly(butadiene-co-acrylonitrile), poly(acrylonitrile) or a combination thereof to prepare a dihydroxyl-functionalized material.

Nonetheless, Appellants have amended claim 23 by defining that the "dihydroxyl-functionalized material has a molecular weight that is substantially unchanged relative to the molecular weight of said dicarboxylic acid-functionalized starting material."

The Office Action dated February 7, 2003 has stated that in the present invention the molecular weights of the polymers remain essentially unchanged.

Appellants accept the Examiner's conclusion on page 3 of the Office Action dated February 7, 2003 that the molecular weights of the polymers remain **substantially unchanged** during the hydroxyalkylation process according to the present invention:

"...the specification at pages 9 and 12 cited by the applicant clearly contemplate the molecular weights being the same,..."

Appellants have amended claim 23 to indicate that dihydroxyl-functionalized material has a molecular weight that is **substantially unchanged** relative to the molecular weight of the dicarboxylic acid-functionalized starting material, as it has been shown clearly on pages 9 and 12 of the specification and concluded by the Examiner on page 3 of the Office Action dated February 7, which concedes that Appellants have indeed shown that the hydroxyalkylation process according to the present invention is carried out without substantially increasing the molecular weights of the starting materials.

The final Office Action states:

For the record, it is noted that if the molecular weights of Examples 1 and 2 as measured in Example 10 are in fact number average molecular weights and the molecular weight of the commercial CTBN is in error as alleged by applicant, then based upon the carboxyl numbers of the starting material and the hydroxyl numbers for the hydroxylated product, it follows that the CTBN and HTBN polymers can not have a functionality of two, i.e., on average, the CTBN and the HTBN polymers would need to be approximately monofunctional. Otherwise it would seem that applicant must also conclude that both the carboxyl and the hydroxyl numbers are also wrong.

First, Appellants did not allege that "the molecular weight of the commercial CTBN is in error." Whether the molecular weight of the commercial CTBN is in error is not a central issue for the patentability of the present claims. However, for the record, in response to an Office Action, Appellants stated the following:

Applicants point out that the molecular weights of the commercial CTBN, which is the starting materials provided by the manufacturer, have molecular weights of 3,800 provided by the manufacturer and are measured by the old and generally not very reliable method of **Vapor Pressure Osmometry (VPO)** (see page 20, lines 1-5, of the present specification).

In contrast, the molecular weights of the HTBN's of Examples 10 and 11, which are the products of the hydroxyalkylation process according to the present invention, were measured using a more modern and the more reliable method of **Size Exclusion Chromatography**, using a **polystyrene standard** to calibrate the system. The molecular weights of the HTBN's of Examples 10 and 11, are Number Average Molecular Weights, which are compared with the Number Average Molecular Weight of commercial HTBN, also determined by the applicants using Size Exclusion Chromatography, with polystyrene standard (see pages 26-27, of the present specification).

Thus, the two methods described above do not produce the same numbers for the measured molecular weights.

However, the comparison was used to indicate that Molecular Weight of the products of the hydroxyalkylation process according to the present invention, were comparable to that of the commercial HTBN provided by the manufacturer (see pages 26-27, of the present specification).

Therefore, Appellants did not allege that "the molecular weight of the commercial CTBN is in error." The numerical value of molecular weight of a polymer depends on the method used to determine the molecular weight of the polymer. The values obtained for a molecular weight by one method would be very different than the values obtained for the same polymer by a different method. The fact that these numbers are different does not mean that one is correct and the other is in error. Thus, in order to compare two polymers, one compares two molecular weights that are determined by the same method.

Second, the manufacturer of the commercial CTBN reports that the commercial CTBN has a Number Average Molecular weight of 3,800 as determined by Vapor Pressure Osmometry (VPO) and has a functionality of 1.9 (see page 20, lines 1-5, of the present specification).

The logic applied in the final Office Action to arrive at the conclusion that the commercial CTBN must be monofunctional is not clear. These numbers are provided by the manufacturer. The values obtained for a molecular weight by one method would be different than the values obtained for the same polymer by a different method. Therefore, the fact that these numbers are different does not mean that one is correct and the other is in error, as alleged by the final Office Action. The comparison was used only to indicate that Molecular Weight of the products of the hydroxyalkylation process according to the present invention, were comparable to that of the commercial HTBN provided by the manufacturer (see pages 26-27, of the present specification).

Regarding the hydroxyl numbers and the acid numbers of the HTBN, on page 27, line 8 to page 28, line 6, the specification reads:

Hydroxyl Number

We also determined the hydroxyl number for HTBN prepared by the process of the present invention and its commercial counterpart. The hydroxyl number is a measure of the concentration of hydroxyl groups on the polymeric structure and is desirable to ensure that the stoichiometric equivalent of diisocyanate be employed in the production of the block-prepolymer intermediate. Hydroxyl numbers were determined here by standard titration techniques and are reported here as mg of KOH/g of polymer.

We found the commercial HTBN to possess a hydroxyl number of 22.7 and the HTBN prepared from ethylene carbonate in Examples 1 and 2 supra to possess a hydroxyl number of 22.2 and 21.4.

Acid Numbers

The acid number is the amount of free carboxylic acid and is used to determine residual unreacted acid at the completion of the reaction. It is desirable for the HTBN to have a low acid number, particularly when the HTBN is to be used to prepare urethane resins, because acid functionalized polymers (e.g., CTBN) react only slowly and incompletely with isocyanates. We found the process of the present invention to provide materials essentially free of carboxylic acid functionality, which compares favorably with values obtained from commercial HTBN.

In order to determine the acid number of the HTBN, we used standard titration techniques and reported the values as mg of KOH/g of polymer. The HTBN prepared by the process of the present invention exhibited an acid number of less than 0.1, whereas the commercial HTBN exhibited an acid number of about 2.6. Thus, it is seen that with respect to invention acid conversion, the process of the present provides greater than a twenty fold decrease in residual acid, which results in a cleaner

urethane product and is desirable to ensure that the stoichiometric equivalent of diisocyanate be employed in the production of the block-prepolymer intermediate.

The Office Action states the following unsupported conclusion without presenting any facts or proof or describing any method of calculation or describing the logic behind such clearly erroneous conclusion:

... if the molecular weights of Examples 1 and 2 as measured in Example 10 are in fact number average molecular weights and the molecular weight of the commercial CTBN is in error as alleged by applicant, then based upon the carboxyl numbers of the starting material and the hydroxyl numbers for the hydroxylated product, it follows that the CTBN and HTBN polymers can not have a functionality of two, i.e., on average, the CTBN and the HTBN polymers would need to be approximately monofunctional. Otherwise it would seem that applicant must also conclude that that both the carboxyl and the hydroxyl numbers are also wrong.

The manufacturer of the commercial CTBN reports that the commercial CTBN has a Number Average Molecular weight of 3,800 as determined by Vapor Pressure Osmometry (VPO) and has a functionality of 1.9 (see page 20, lines 1-5, of the present specification). Whatever logic being applied by the Office Action to arrive at the conclusion that the commercial CTBN must be monofunctional would have to be faulty, unless the Office Action suggests a plausible explanation as to why "applicant must also conclude that that both the carboxyl and the hydroxyl numbers are also wrong."

Appellants point out that information on the functionality and molecular weight of carboxyl terminated butadiene acrylonitrile copolymers (CTBN) and the corresponding hydroxyl terminated butadiene acrylonitrile copolymer derivatives (HTBN) as well as the

Application No.: 09/341,287
Art Unit: 1713

structure and properties of CTBN are summarized in an article by Y. Okamoto: *Polymer Engineering and Science*, **23** (4), 222 (1983), a copy of which is already on record.

These materials were developed and sold by B. F. Goodrich under the Hycar trade name. The examples in the present application were based on CTBN grade 1300X31 and its derivative HTBN grade 1300X29, which contain 10% acrylonitrile.

The properties of CTBN materials are described in a product brochure published by B. F. Goodrich entitled "Hycar Reactive Liquid Polymers". In this brochure CTBN 1300X31 is described as a carboxyl terminated butadiene acrylonitrile copolymer having a functionality of 1.9, a number average molecular weight (Mn) of 3,800 and an acid number of 28.

The synthesis and production of CTBN, HTBN and related polymers are disclosed in several U.S. patents assigned to B. F. Goodrich including U.S. Patent Nos. 3,285,949 (1966); 3,551,472 (1970); 3,712,916 (1973) and 4,444,692 (1984). It is clear from data in these patents that the products are essentially difunctional. For example, U.S. Patent No. 3,551,472, column 1, lines 53-58, states:

It has now been discovered that it is possible to readily convert these carboxyl terminated liquid polymers to hydroxyl terminated liquid polymers with a high degree of difunctionality, i.e. practically 2, indicative of the fact that a hydroxyl group is located at each end of the polymer chain.

U.S. Patent No. 3,551,472 further describes, in column 2 lines 28-39, the use of calibrated VPO to determine Mn of the polymers and the determination of polymer functionality from Mn and the functional group equivalence as determined by titration with standardized potassium hydroxide solution.

There is no reason to doubt the manufacturer's numbers of the commercial CTBN when the manufacturer reports that the commercial CTBN has a Number Average Molecular weight of 3,800 as determined by VPO with a functionality of 1.9. Further, there is no reason to doubt the molecular weights reported in the present application by the inventor (1) of the HTBN's of Examples 10 and 11, which are Number Average Molecular Weights, and (2) the Number Average Molecular Weight of commercial HTBN, also determined by Appellants using Size Exclusion Chromatography, with polystyrene standard for comparison (see pages 26-27, of the present specification), unless there is a good and sufficient basis for concluding otherwise.

Therefore, the rejection of claim 23, and claims 24-28, 31, 34-37 and 43, which depend therefrom, under 35 U.S.C. §103(a) as allegedly being obvious over Okamoto in view of Merck Index, Wu and/or Yoshino, in further view of Wu or Yoshino, should be reconsidered and these claims should be allowed.

Dependent Claims:

The arguments provided for independent claim 23 above are repeated herein for dependent claims 24-28, 31, 34-37 and 43, because claims 24-28, 31, 34-37 and 43 have been rejected on the same grounds as independent claim 23.

Accordingly, Appellants provide herein further arguments, which relate to the limitations of the dependent claims and any intervening claims.

Each of the above dependent claims defines an aspect of the present invention not taught or described in the cited art, either alone or in combination.

Claim 24 includes the limitation that the dicarboxylic acid-functionalized material has carboxyl-functional groups that can independently be R or R¹ and can be COOH or CAA¹-X-COOH. Further, each A and A¹ can independently be hydrogen, halogen, cyano, linear or branched alkyl having from 1 to about 5 carbon atoms and wherein X is a linear or branched alkyl having from 1 to about 5 carbon atoms. None of the cited art describes such dicarboxylic acid-functionalized materials that are used in the process according to the present invention.

Claim 25 further limits the dicarboxylic acid-functionalized material to a number average molecular weight of from about 3,100 to about 4,200. None of the cited art teaches or suggests dicarboxylic acid-functionalized materials having a number average molecular weight of from about 3,100 to about 4,200 that are used in the process according to the present invention as defined in claim 23.

Claim 26 further defines the hydroxyalkylating reactant as being a carbocyclic carbonate, a carbocyclic sulfite or a combination thereof. Claim 27 recites specific examples of the carbocyclic carbonate which include ethylene carbonate, 1,3-propylene carbonate, 2-methyl-1,2-ethylene carbonate, 3-methyl-1,3-propylene carbonate, 1,2-dimethyl ethylene carbonate, 2,2-dimethyl butylene carbonate and combinations thereof. Claim 28 further defines the carbocyclic carbonate as ethylene carbonate.

Again, none of the cited references discloses, teaches or suggests that a hydroxyalkylating reactant, such as, a carbocyclic carbonate, a carbocyclic sulfite or a combination thereof, can be used in a process as defined in claim 23.

Claim 31 further defines the dihydroxyl-functionalized material as being a dihydroxyl-functionalized polymer, such as, polybutadiene, poly(butadiene-co-acrylonitrile), polyacrylonitrile, or a combination thereof. None of the cited art teaches or

suggests that dihydroxyl-functionalized materials based on these polymers can be used in a process as defined in claim 23.

Claim 34 further defines the phase transfer catalyst as being a quaternary ammonium halide, phosphonium halide, sulfonium halide, crown ether, calixarene and a combination thereof. Claim 35 more specifically defines the phase transfer catalyst as being tetrabutyl ammonium iodide, tetraethyl ammonium iodide, benzyl trimethyl ammonium chloride or ethyl triphenylphosphonium bromide. None of the cited art teaches or suggests that these phase transfer catalyst can be used in a process as defined in claim 23.

Claim 36 further defines the molar ratio of the hydroxyalkylating reagent to the dicarboxylic acid-functionalized material to be from about 3.8 to about 4.5. Claim 37 further defines the carboxylic acid-functionalized material is being a member selected from carboxylic acid-functionalized polybutadiene and carboxylic acid-functionalized poly(butadiene-co-acrylonitrile). None of the cited art teaches or suggests these limitation.

Claim 43 is identical in scope with claim 23. Appellants would be willing to cancel claim 43 if claim 23 is either entered or allowed. None of the cited references discloses, teaches or suggests, either alone or in combination, that a dihydroxyl-functionalized material having a molecular weight that is substantially unchanged relative to the molecular weight of said dicarboxylic acid-functionalized starting material can be prepared by a process as defined in claim 43.

In view of the foregoing, a person of ordinary skill in the art would not be motivated to replace ethylene oxide with ethylene carbonate. Instead, such a person would avoid replacing the ethylene oxide. The toxicity of a chemical alone is insufficient to provide the requisite motivation to replace ethylene oxide with ethylene carbonate

Application No.: 09/341,287
Art Unit: 1713

and further replace the tertiary amine catalyst with a phase transfer catalyst and still further, replace the various carboxylic acid starting materials with a dicarboxylic acid-functionalized polymer of polybutadiene, poly(butadiene-co-acrylonitrile), poly(acrylonitrile) or a combination thereof to prepare a dihydroxyl-functionalized material. Such motivation is not provided in the above-cited references, either alone or in combination. Absent a teaching or suggestion to provide motivation to combine, the cited references are not properly combinable because a person of ordinary skill in the art would not be able to arrive at the claimed invention except through either extensive experimentation or impermissible hindsight. Therefore, the rejection of claims 23-28, 31, 34-37 and 43 under 35 U.S.C. §103(a) as being obvious should be reversed and these claims should be allowed.

Based on the foregoing, reconsideration and withdrawal of the rejections of the pending claims are requested and indication of their allowability is likewise requested.

Respectfully submitted,

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APPENDIX

Claims 23-28, 31, 34-37 and 43, herein on appeal, are set forth below.

23. A process for preparing a dihydroxyl-functionalized material by hydroxyalkylating a dicarboxylic acid-functionalized material, said process comprising the step of: reacting as reactants: (a) a dicarboxylic acid-functionalized material selected from the group consisting of dicarboxylic acid-functionalized polymers of: polybutadiene, poly(butadiene-co-acrylonitrile), poly(acrylonitrile) and combinations thereof; and (b) a hydroxyalkylating reagent selected from the group consisting of: a carbocyclic carbonate, a carbocyclic sulfite and combinations thereof; in the presence of: (c) a phase transfer catalyst under conditions sufficient to form a dihydroxyl-functionalized material;

wherein said dihydroxyl-functionalized material has a molecular weight that is substantially unchanged relative to the molecular weight of said dicarboxylic acid-functionalized starting material.

24. The process according to claim 23, wherein said dicarboxylic acid-functionalized material has carboxyl-functional groups independently selected from the group consisting of: R and R¹, wherein each R and R¹ is independently selected from the group consisting of: COOH or CAA¹-X-COOH, wherein each A and A¹ is independently selected from the group consisting of: hydrogen, halogen, cyano, linear or branched alkyl having from 1 to about 5 carbon atoms and wherein X is a linear or branched alkyl having from 1 to about 5 carbon atoms.

25. The process according to claim 23, wherein said dicarboxylic acid-functionalized material has a number average molecular weight of from about 3,100 to about 4,200.

26. The process according to claim 23, wherein said hydroxyalkylating reactant is a member selected from the group consisting of carbocyclic carbonate and carbocyclic sulfites.

27. The process according to claim 26, wherein said carbocyclic carbonate is a member selected from the group consisting of ethylene carbonate, 1,3-propylene carbonate, 2-methyl-1,2-ethylene carbonate, 3-methyl-1,3-propylene carbonate, 1,2-dimethyl ethylene carbonate, 2,2-dimethyl butylene carbonate and combinations thereof.

28. The process according to claim 26, wherein said carbocyclic carbonate is ethylene carbonate.

31. The process according to claim 23, wherein said dihydroxyl-functionalized material is selected from the group consisting of the dihydroxyl-functionalized polymers of: polybutadiene, poly(butadiene-co-acrylonitrile), polyacrylonitrile, and combinations thereof.

34. The process according to claim 23, wherein said phase transfer catalyst is a member selected from the group consisting of quaternary ammonium halides, phosphonium halides, sulfonium halides, crown ethers, calixarenes and combinations thereof.

35. The process according to claim 23, wherein said phase transfer catalyst is a member selected from the group consisting of tetrabutyl ammonium iodide, tetraethylammonium iodide, benzyl trimethyl ammonium chloride and ethyl triphenylphosphonium bromide.

36. The process according to claim 23, wherein the molar ratio of said hydroxyalkylating reagent to said dicarboxylic acid-functionalized material is from about 3.8 to about 4.5.

37. The process according to claim 23, wherein said carboxylic acid-functionalized material is a member selected from the group consisting of carboxylic acid-functionalized polybutadiene and carboxylic acid-functionalized poly(butadiene-co-acrylonitrile) .

43. The process according to claim 23, wherein said dihydroxyl-functionalized material has a molecular weight that is substantially unchanged relative to the molecular weight of said dicarboxylic acid-functionalized starting material.